Issue 827

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eUpdate

11/13/2020

These e-Updates are a regular weekly item from K-State Extension Agronomy and Kathy Gehl, Agronomy eUpdate Editor. All of the Research and Extension faculty in Agronomy will be involved as sources from time to time. If you have any questions or suggestions for topics you'd like to have us address in this weekly update, contact Kathy Gehl, 785-532-3354 kgehl@ksu.edu, or Dalas Peterson, Extension Agronomy State Leader and Weed Management Specialist 785-532-0405 dpeterso@ksu.edu.

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1. Check terraces now for needed repairs and maintenance

In a dry fall, this window of time between harvest and when the snow flies can be a good time to evaluate and perform maintenance on terraces. In Kansas, over 9 million acres of land is protected by more than 290,000 miles of terraces, making Kansas #2 in the U.S. for this soil and water conservation practice. To accomplish the goal of erosion control and water savings, terraces must have adequate capacity, ridge height, and channel width.

Without adequate capacity to carry water, terraces will be overtopped by runoff in a heavy storm. Overtopping causes erosion of the terrace ridge, terrace back slope, and lower terraces and may result in severe gullies. Terraces are typically designed to handle runoff from a 1-in-10-year storm. The rainfall amounts for such a storm are approximately five inches for eastern Kansas, four inches for central, and three inches for western Kansas during a 24-hour period.

Terraces need regular maintenance to function for a long life. Erosion by water, wind, and tillage wears the ridge down and deposits sediment in the channel, decreasing the effective ridge height, and channel capacity. The amount of capacity loss depends on the type and number of tillage operations, topography, soil properties, crop residue, and precipitation. Terrace maintenance restores capacity by removing sediment from the channel and rebuilding ridge height.

Typically, more frequent maintenance is required for steep slopes and/or highly erodible soils. Annual maintenance is necessary for intense tillage operations and heavy rainfall runoff. Less frequent maintenance is often adequate with high residue levels or where lower rainfall occurs and runoff intensity is low.

Check for needed repairs

Terraces degrade naturally by erosion and sediment, and can be damaged by machinery, animals, settling, and erosion. Check terraces and terrace outlets regularly (at least annually) for needed repairs. The best time to check is after rains, when erosion, sedimentation, and unevenness in elevation are easiest to spot. Specific items to note are overtopping, low or narrow terrace ridges, water ponding in the channel, terrace outlets, erosion, and sediment clogging near waterway or pipe outlets.

Reshaping the terrace

Terrace maintenance can be done with virtually any equipment that efficiently moves soil. Common tools include those that turn soil laterally, such as a moldboard plow, disk plow, one-way, terracing blade (pull-type grader), or 3-point ridging disk (terracing disk, etc.); those that convey or throw soil (belt terracer, scraper, whirlwind terracer, etc.); and those that push or drag soil (dozer blade, straight-wheeled blade, 3-point blade, etc.).

This article discusses procedures for the common plow. For other equipment, get advice from manufacturers, other users (contractor), or experiment to find what works best.

The primary objective in reshaping the terrace is to move soil from the channel to the ridge. Work done on the terrace back slope or cut slope above the channel may help maintain or improve shape

but does little to add significant ridge height or channel capacity. Because of improved efficiency, a two-way (rollover) plow is ideal for terrace maintenance. It can usually achieve the desired shape with fewer passes than the conventional plow. Turn the soil in one direction to counteract erosion or turn it in either direction to clear the channel or raise and widen the terrace ridge.

The number of passes required for maintenance depends on the size of the tool, the depth of operation, travel speed (which controls distance of throw), and the amount of soil moved. The plow throws soil further at higher speeds, so a minimum ground speed of 5 mph in loose soil is suggested, but 6 mph or more is better.

Maintenance controls terrace shape. Assess what needs to be done before beginning maintenance. Compare the existing cross-section shape with the desired shape and size, and determine where soil should be removed and where it should be placed for the desired result. Back furrows are placed where more soil is needed, while dead furrows are located where soil needs to be removed. In this way, passes or sets of passes with the equipment are located to achieve the desired results.

Terrace dimensions can be changed by carefully planned placement of back furrows and dead furrows. Large changes in dimension and shape require several sets of passes with the tools or earthmoving equipment. Plan the terrace cross-section shape and size and terrace slope segment length to fit current and future tillage, planting, and harvesting equipment size.

The number of rounds or passes with maintenance equipment depends on the beginning shape of the terrace, size of equipment, and the desired size and shape. If in doubt, make more passes rather than stop too soon. Remember, the loose soil will settle a lot.

Plowing the ridge. The terrace ridge is raised and widened by plowing up from both sides as shown in Figure 1. When a 2-way plow is used, plow just the front slope from the channel to the ridge. Plowing the backslope makes it steeper.

Figure 1. Double back furrow. Arrow indicates the back furrows meeting on the top of the ridge. Image from K-State Research and Extension.

The back furrows are placed on top of the ridge, and the dead furrows are placed at the desired center of the channel and at the toe or beyond on the backslope. Avoid making a depression on the backslope by varying where the dead furrow is placed. Plowing the ridge is recommended for maintaining or adding ridge height. To make the ridge wider and not so sharply peaked, the back

furrows should come together, but not overlap and make additional rounds. Correct a narrow peaked ridge resulting from too few passes by moving the plow over only one or two bottom widths with each pass. This process requires many more rounds.

To make the terraces slopes long enough to fit equipment, always leave dead furrow the desired distance from the ridge. For the three-segment shape, locate the back and dead furrows in the same place each year, keeping the cross-section uniform in size and shape. Vary the back furrow and dead furrow locations each time to maintain the rounded shape of the channel and ridge for the large smooth section.

Plowing the channel. Sometimes even when the ridge is large enough, the channel can have inadequate capacity. To enlarge and widen the terrace channel, plow out to both sides as shown in Figure 2.

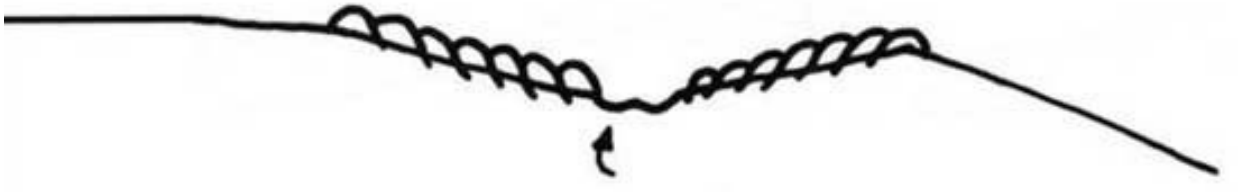

Figure 2. Enlarging and widening the terrace channel. Arrow indicates the two dead furrows meeting at the center of the channel. Image from K-State Research and Extension.

Back furrows are placed on the ridge and on the uphill cut-slope side the same distance from the desired center of the channel. Begin at a distance equal to that from ridge to desired channel center. A double side-by-side dead furrow should result at the desired channel center. Locate the plow back furrow on the ridge and the dead furrows in the desired channel bottom to achieve and maintain the desired shape. Vary the back furrow location to avoid leaving a large ridge on the cut slope.

Plowing out the channel periodically is recommended for steeper slopes to help maintain adequate channel capacity. Alternating between plowing the channel out and plowing the up from one time to the next is a good practice.

Consider conservation agriculture practices to increase terrace life

When silt bars and sediment deposits accumulate frequently in a terrace channel, excessive erosion is the cause. A change in tillage and cropping practices is needed to correct this cause. Adding cover crops to a system, switching to no-till or conservation tillage, and using crop rotations that retain crop residue will reduce erosion substantially. This will reduce the frequency of terrace maintenance needs. Many no-till producers find terrace systems require little maintenance. Although runoff still occurs, there is very little soil movement in a no-till system. Remember, terraces are there to help in extreme weather events, and terraces prevent gullies and are only a part of an overall erosion control plan. Conservation farming methods, especially retaining crop residue or using cover crops, compliments erosion control structures and has been shown to be both economically and

environmentally sound.

For more information, refer to publication Terrace Maintenance, C-709 available online at:
http://www.ksre.ksu.edu/bookstore/pubs/C709.pdf

Another great resource is this KSRE YouTube video: Basics of Terrace Maintenance:
http://youtu.be/CcoITeP9QRA

Additional sources for technical information include your local USDA-Natural Resources Conservation Service and County Conservation District offices.

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2. Safety first when planning deep tillage or earthwork: Call before you dig!

After harvest, many producers might head to the field for deep tillage such as ripping, or to make earthwork repairs around the farm. A few days before you want to start these activities, it's worth a call to 811 for your safety and to prevent expensive damage to underground utilities. The website, http://call811.com, has easy-to-follow instructions for requesting this free service and detailed information concerning why you need to know what's below.

A video produced by Marathon Oil tells the story of a farm family and their close-call with a pipeline when installing tile drains. The landowner knew where the pipeline entered and exited the field, and they assumed the pipeline was straight— it wasn't. Watch this 6-minute, eye-opening video for the whole story; https://youtu.be/oe-iknpYzF8.

Sadly, fatal accidents do happen in soil excavations. If you dig any trenches or soil pits, safety should be considered from the very beginning of the project. Soils with sandy textures are more susceptible to a collapse than soils with a higher clay content. If standing water is present in the pit, the walls are more apt to collapse. Digging in soils that have been disturbed before, such as digging next to a hydrant or foundation, for example, means that the soil is far less stable than you might expect if that soil had never been disturbed before.

There are Occupational Safety and Health Administration (OSHA) guidelines on excavation safety, such as when it is necessary to shore the walls of a soil pit or trench. One important consideration is soil should be piled a minimum of 2 feet away from the walls of the trenches for two reasons:

1. Soil clods or excavating tools could roll back into the trench and cause injury to occupants.
2. Helps reduce the risk of a trench collapse by keeping the weight of the soil piles away from the trench edges.

Even if a soil pit is 5 feet deep or less, it is a good idea to angle the edges of the soil pit, especially if the texture is sandy, the soil is wet, or if the soil is otherwise unstable. This does create more disturbance, but if it prevents an accident, it's worth it.

For more information on trenching and excavation safety, see the following OSHA publication:

Trenching and Excavation Safety, https://www.osha.gov/Publications/osha2226.pdf

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3. Factors to consider in winter survival of wheat

The official start of winter is still over a month away, but Kansas has already experienced winter-like weather this fall. This article discusses some of the factors to consider when evaluating the outlook for winter survival of wheat.

Cold acclimation of the crop and maintenance of winter hardiness

During the fall, winter wheat seedlings spend approximately the first month developing their first leaves, the crown, and a secondary root system. All the while, the seedlings are building and storing the energy needed to go through the cold acclimation process and survive the winter. Normally, seedlings will need a minimum of 4-5 leaves and one or two tillers to build up enough stored energy reserves to survive the winter. Ideally, the wheat plant would have 3 to 5 tillers prior to the onset of the winter. This might be a challenge this year in fields that, although planted on time, did not receive enough precipitation to emerge until recently and thus will have less time to produce leaves and tillers. Seedlings will have a better chance of winter survival if their crowns are well developed, in firm soil, about one inch below the soil surface.

Winter hardiness or cold tolerance is a physiological process triggered by gradually cooling temperatures in the fall. During the process of cold acclimation, certain genes within winter wheat begin to initiate the production of "anti-freeze" type substances to protect the cell membranes. The process of cold acclimation within a sufficiently developed wheat seedling begins when soil temperatures at crown depth fall below about 50 ^{o}F (Figure 1).

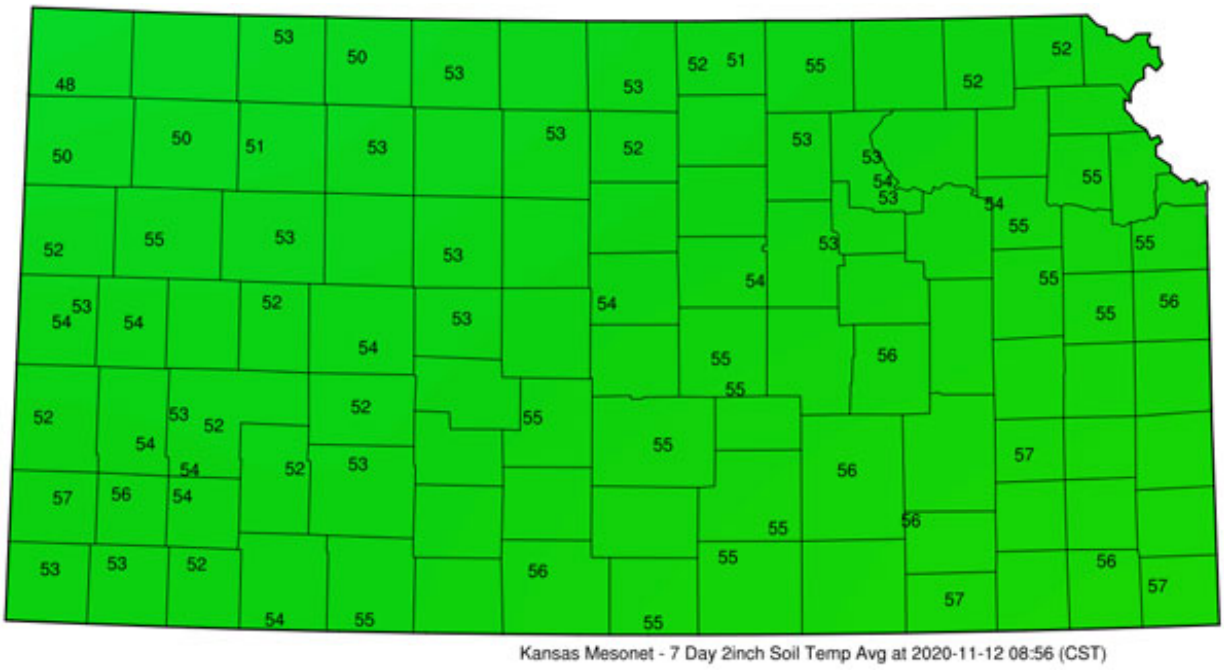

Figure 1. Average 2-inch soil temperature during the week of November 6 – 12, 2020. Temperatures for the majority of the state were above the 50 °F threshold needed to initiate the process of cold acclimation in winter wheat. Data and map by Kansas Mesonet.

Below 50 °F, there is an inverse relationship between crown temperatures and cold acclimation, meaning that plants will acclimate twice as fast when crown temperatures are 32 °F as compared to 40 °F. Photoperiod also plays a role in the process of cold hardening, with shorter days and longer nights helping initiate the process. Winter survival depends on the crown remaining alive and the substances that produce cold acclimation are most needed within the crown.

It takes about 4 to 6 weeks of soil temperatures below 50 °F at the depth of the crown for winter wheat to fully cold harden. The colder the soil at the depth of the crown, the more quickly the plants will develop winter hardiness. However, cold hardiness is not a static state. After the cold hardening process begins in the fall, wheat plants can rapidly un-harden when soil temperatures at the depth of the crown get above 50 °F. However, the plants will re-harden as crown temperatures cool below °F again. By the time winter begins, winter wheat will normally have reached its maximum level of cold hardiness. Wheat in Kansas normally has its maximum level of winter hardiness from mid-December to mid-January, unless there are high temperatures during that period.

Even during the depths of winter, winter wheat is still respiring and roots may be growing – as long as the ground is not frozen. It is not unusual to find a much more developed crown root system in early February than existed in early December. It is also not unusual to see some green leaves intermingled with straw-colored or pale leaves in the winter (Figure 2). The fact that some of the leaves have some green color does not mean the wheat is not cold tolerant.

Figure 2. Wheat plants starting to show straw-colored or pale leaf tips as a consequence of cold temperatures near Healy. Brown, dried leaves do not necessarily indicate winter injury. The only way to assess the plant's condition following winter is to examine the crown for winterkill. Photo by Romulo Lollato, K-State Research and Extension.

Once winter wheat has reached the level of full cold hardiness, it will remain cold hardy as long as crown temperatures remain below about 32 ^{o}F – assuming the plants had a good supply of energy going into the winter.

If soil temperatures at the crown depth rise to 50 ^{o}F or more for a prolonged period, there will be a gradual loss of cold hardiness, even in the middle of winter. The warmer the crown temperature during the winter, the faster the plants will start losing their maximum level of cold hardiness. Winter wheat can re-harden during the winter if it loses its full level of winter hardiness, but will not regain its maximum level of winter hardiness.

Even at its maximum level of winter hardiness, winter wheat can still be injured or even killed by cold temperatures if temperatures at the crown level reach single digits or if plants are subjected to long periods when soil temperatures approach the minimum survival temperatures. Thus, winter survival is affected by not only how cold it gets, but also by the duration of cold temperatures. As soil temperatures at the crown level rise to 50 ^{o}F or more, usually in late winter or spring, winter wheat will gradually lose its winter hardiness entirely. Photoperiod also plays a role in this process, and there are varietal differences in winter hardiness. When the leaves switch from being prostrate to upright, the plants will have completely de-hardened. Once winter hardiness is lost in the spring, early spring freeze events such as those in mid-April 2020 can cause damage to the plants.

Fall root system development

Good top growth of wheat doesn't necessarily indicate good root development. Poor root development is a concern where conditions have been dry. Where wheat plants have a good crown root system and two or more tillers, they will tolerate the cold better. If plants are poorly developed going into winter, with very few secondary roots and no tillers, they will be more susceptible to winterkill or desiccation, especially when soils remain dry. Poor development of secondary roots may not be readily apparent unless the plants are pulled up and examined (Figure 3). If secondary roots are poorly developed, it may be due to dry soils, poor seed-to-soil contact, very low pH, insect damage, or other causes.

Figure 3. Differences in wheat development prior to winter dormancy. Both examples shown above should be able to make it through the winter, although the more-developed root system in the photo to the right will be able to provide water and nutrients with less limitations to the plant during the winter. Photos by Romulo Lollato, K-State Research and Extension.

Soil temperatures at the crown level

Soil temperatures at crown level depend on snow cover, moisture levels in the soil, and seedbed conditions. Winterkill is possible if soil temperatures at the crown level (about one-inch-deep if the wheat was planted at the correct depth) fall into the single digits. If there is at least an inch of snow on the ground, the wheat will be insulated and protected, and soil temperatures will usually remain above the critical level. In addition, if the soil has good moisture, it is possible that soil temperatures at the crown level will not reach the critical level even in the absence of snow cover. However, if the soil is dry –as it is this year in a large portion of north central and northwest Kansas (Figure 4, upper panel) and there is no snow cover, there may be the potential for winterkill, especially on exposed slopes or terrace tops, depending on the condition of the plants. Most of the wheat growing region in the state has not received substantial precipitation for over 30 days, and the topsoil is possibly dry through central and western Kansas (Figure 4, lower panel). Dry soils and loose seedbeds warm up and cool down much faster than moist or firm soils, contributing to winter injury.

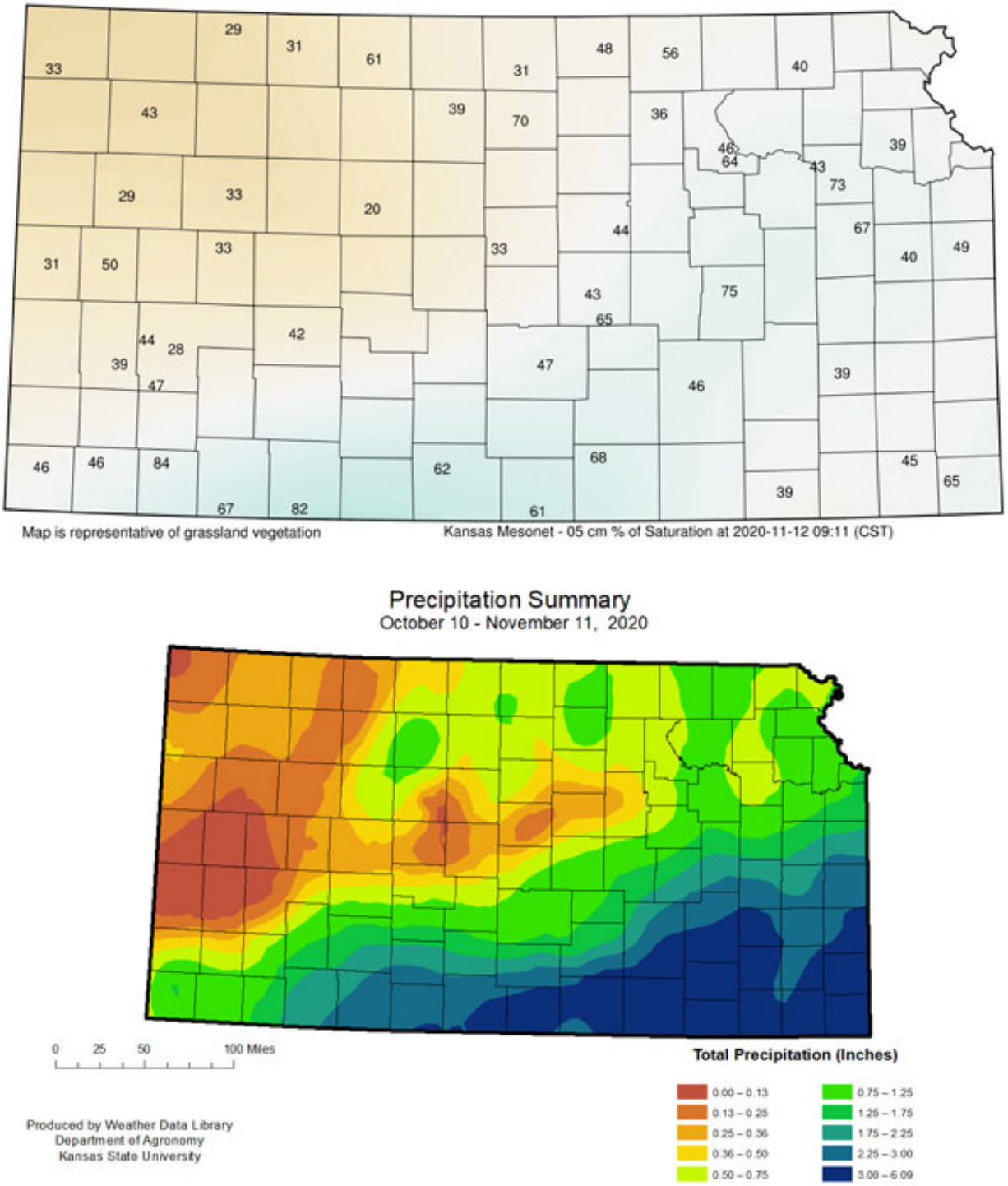

Figure 4. Percent soil moisture in the surface 2" as of Nov. 12, 2020 (upper panel), and cumulative precipitation from October 10 – November 11, 2020 (lower panel). While southeastern Kansas received as much as 6.09 inches, the majority of central and western Kansas, where wheat is mostly grown, received less than 0.50 inches. Dry topsoil might result in greater exposure to winterkill, especially if the canopy is not well developed. Map and data from Kansas Weather Data Library.

Is the crown well protected by soil?

If wheat is planted at the correct depth, about 1.5 to 2 inches deep, and is in good contact with the soil, the crown should be about one inch below the soil surface and well protected from the effects of cold temperatures. If the wheat seed was planted too shallow, then the crown will have developed too close to the soil surface and will be more susceptible to winterkill. Also, if the seed was planted into loose soil or into heavy surface residue, the crown could be more exposed and susceptible to cold temperatures and desiccation.

Is there any insect or disease damage to the plants?

Plants may die during the winter, not from winterkill, but from the direct effects of a fall infestation of Hessian fly. Many people are familiar with the lodging that Hessian fly can cause to wheat in the spring, but fewer recognize the damage that can be caused by fall infestations of Hessian fly. Wheat infested in the fall often remains green until the winter when the infested tillers gradually die. Depending on the stage of wheat when the larvae begin their feeding, individual tillers or whole plants can die. If the infestation occurs before multiple tillers are well established, then whole plants can die. If the plants have multiple tillers before the plants are infested, then often only individual tillers that are infested by the fly larvae will die.

The key to being able to confirm that the Hessian fly is the cause of the dead tillers is to carefully inspect the dead plants or tillers for Hessian fly larvae or pupae. This can be done by carefully removing the plant from the soil and pulling back the leaf material to expose the base of the plant. By late winter all of the larvae should have pupated and thus the pupae should be easily detected as elongated brown structures pressed against the base of the plant. The pupae are fairly resilient and will remain at the base of the plant well into the spring.

Damage from winter grain mites, brown wheat mites, aphids, and crown and root rot diseases can also weaken wheat plants and make them somewhat more susceptible to injury from cold weather stress or desiccation.

Fall armyworms and army cutworms may have fed on emerging wheat in the previous month, leaving bare patches. If the worms were fall armyworms, they have died by now. If the worms were army cutworms, they will overwinter where they are in the soil and continue to feed on wheat plants anytime the temperature is 45 ^{o}F or higher from now through around April.

If you have bare patches now, it is a good idea to keep an eye on them and if they slowly expand over the winter, get out and check in the soil around the base of the plants to see if there are small worms curled up about an inch or two below the surface, especially in loose soils. A spot application of a registered insecticide on a warm (above 55 ^{o}F) winter afternoon will do a pretty good job of controlling the worms and allow the plants to come back in the spring as these worms only feed on the above-ground leaf tissue, and not on the roots or crown.

Symptoms of winter survival problems

Symptoms of winterkill will be more apparent when the weather warms up and plants start to green up early spring. If plants are killed outright by cold temperatures, they will not green up next spring. But if they are only damaged, it might take them a while to die. In some cases, damaged plants will green up and then slowly go “backwards” and eventually die. This happens because although there

may be enough nutrients in the crown to allow the plants to green up, the winter injury causes vascular damage so that remaining nutrients cannot move, or root rot diseases move in and kill the plants. This slow death is probably the most common result of winter injury on wheat.

Direct cold injury is not the only source of winter injury. Under dry soil conditions, wheat plants may suffer from desiccation. This can kill or weaken plants, and is actually a more common problem than direct cold injury.

Summary

Ideally wheat plants should have at least 1-2 tillers and 3-5 leaves, as well as a good crown root system development, when going into the winter. However, many Kansas wheat fields emerged relatively late during the 2020-21 growing season due to dry soil conditions, and has faced below-average temperatures, which slowed down crop development. A fall with open field conditions, gradually falling soil temperatures, and little snow cover until freeze-up, will contribute to winter hardiness development by the wheat crop. During the winter, moist and firm soil, as well as at least an inch snow cover, will help buffer and insulate crown temperatures and increase the chances of winter survival.

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4. Update on drought conditions in Kansas - November 13, 2020

For the week ending November 10, 2020, statewide precipitation averaged 0.34 inches, 87 percent of normal. Again, the significant precipitation was confined to a small part of Kansas, the North Central region (Figure 1). The greatest precipitation reported for the week was 1.60 inches at Plainville 4WNW, Rooks County, on the 10th. The North Central Division was the focal point for the highest precipitation in the state with an average of 0.75 inches, 227% of normal (Figure 2). The driest climate division was the Northwest with an average precipitation of 0.05 inches, 23% of normal.

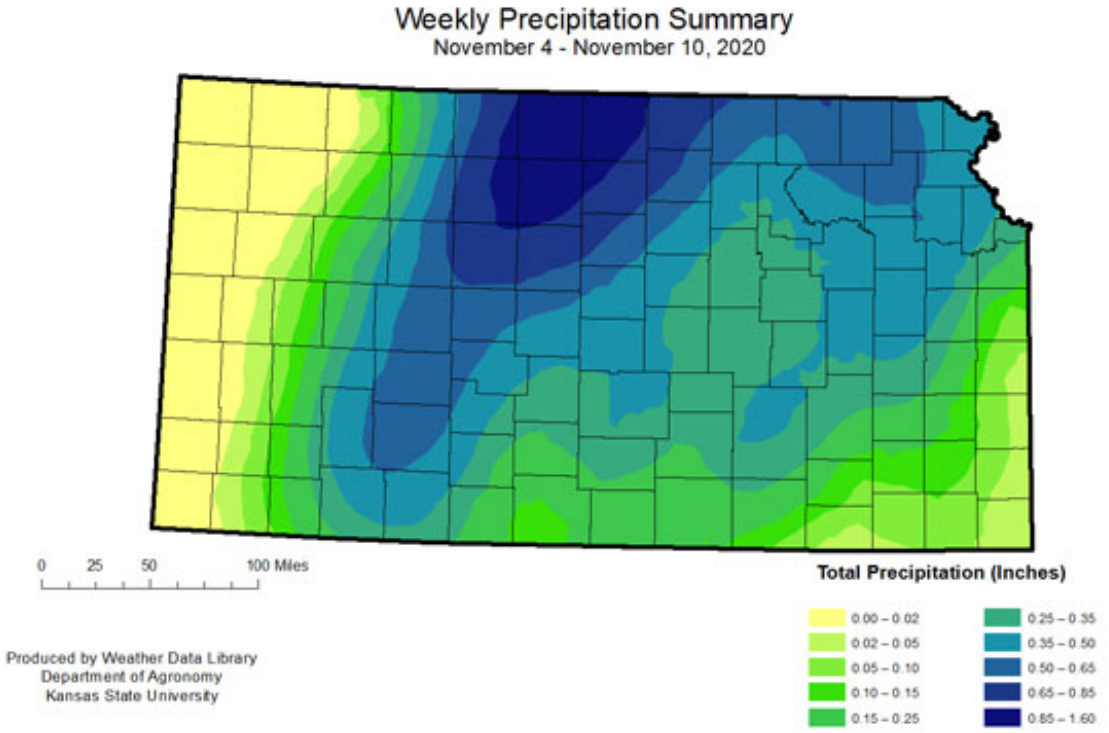

Figure 1. Total precipitation (inches) recorded for the week of November 4 – November 10, 2020. Map by the Kansas Weather Data Library.

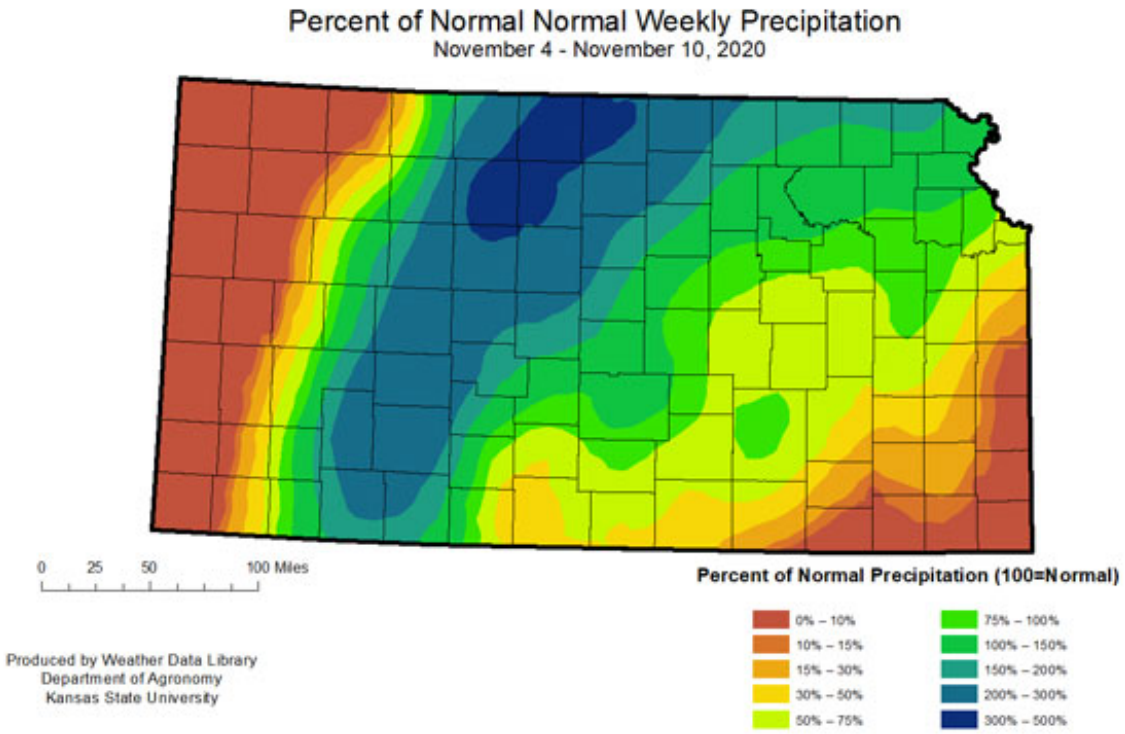

Figure 2. Percent of normal precipitation for the week of November 4 – November 10, 2020. Values less than 100 indicate below-normal amounts. Map by the Kansas Weather Data Library.

The week mostly consisted of much warmer-than-normal temperatures. Although, the week did finish on an average to slightly below normal note. With a 75 ^{o}F temperature swing during the period, the highest reading was 89 ^{o}F reported at Tribune 14N, Greeley County, on the 5th. The coldest temperature reported was 14 ^{o}F at Colby 1S, on the 9th. The state temperature averaged 59.0 ^{o}F for the week, 12.6 degrees warmer than normal (Figure 3). The North Central Division was the warmest with an average of 59.3 ^{o}F, 14.1 degrees warmer than normal. The South Central Division was the coolest at 58.9 ^{o}F, 10.6 degrees warmer than normal.

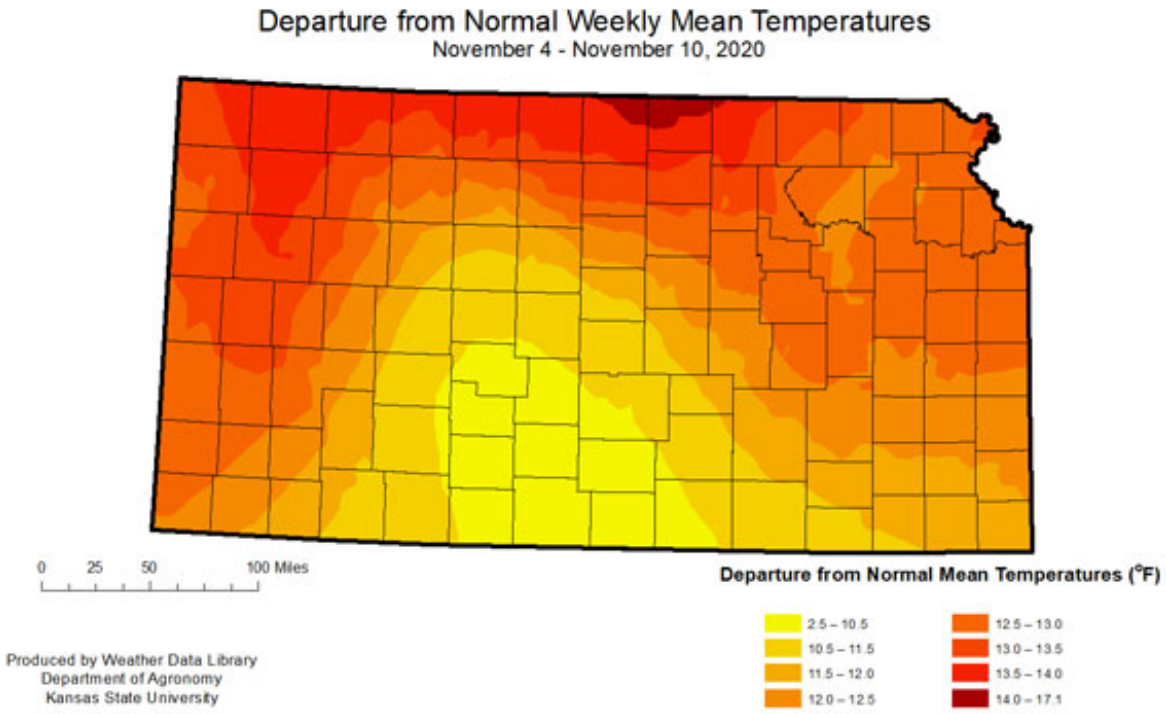

Figure 3. Departure from normal weekly mean temperatures for week of November 4 – November 10, 2020.

While the precipitation and cooler temperatures to end the week were quite noticeable, the previous warmer than normal temperatures and breezy winds offset much of that benefit. As a result, there was no change in the Drought Monitor with nearly 12% of the state in "Severe" or worse drought (Figure 4 and Figure 5). Despite no changes, the gusty winds (which did result in several large fires) and warmer temperatures led to increased moisture demands across the north/northwest part of the state during the period (Figure 6).

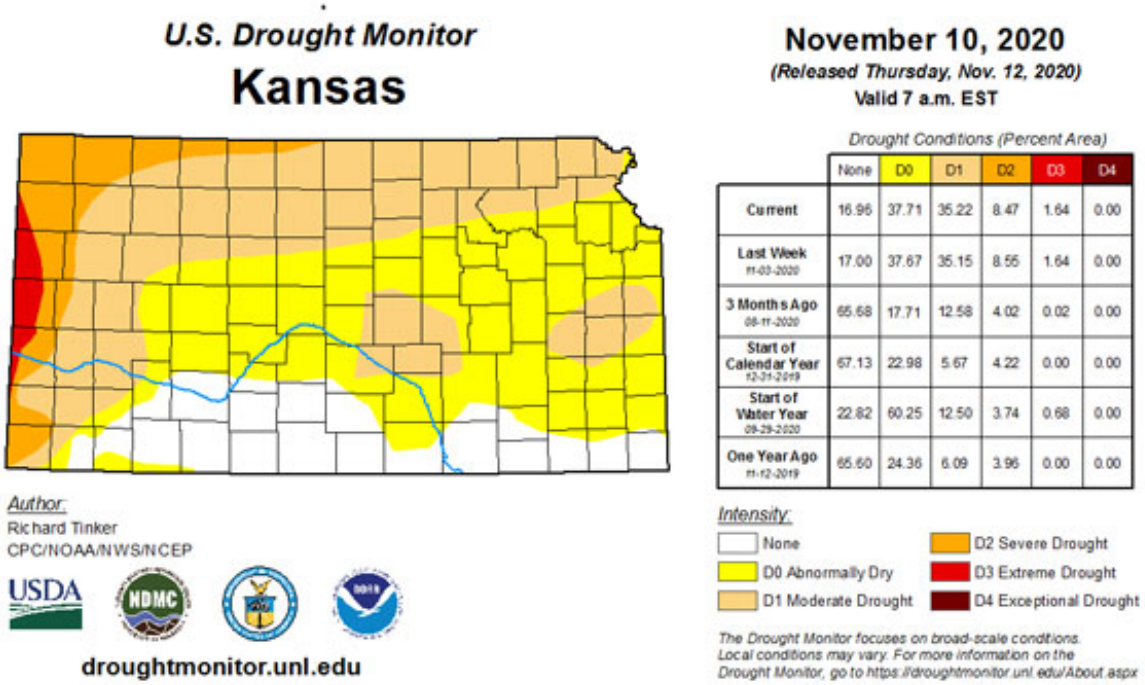

Figure 4. Current weekly drought status (U.S. Drought Monitor)

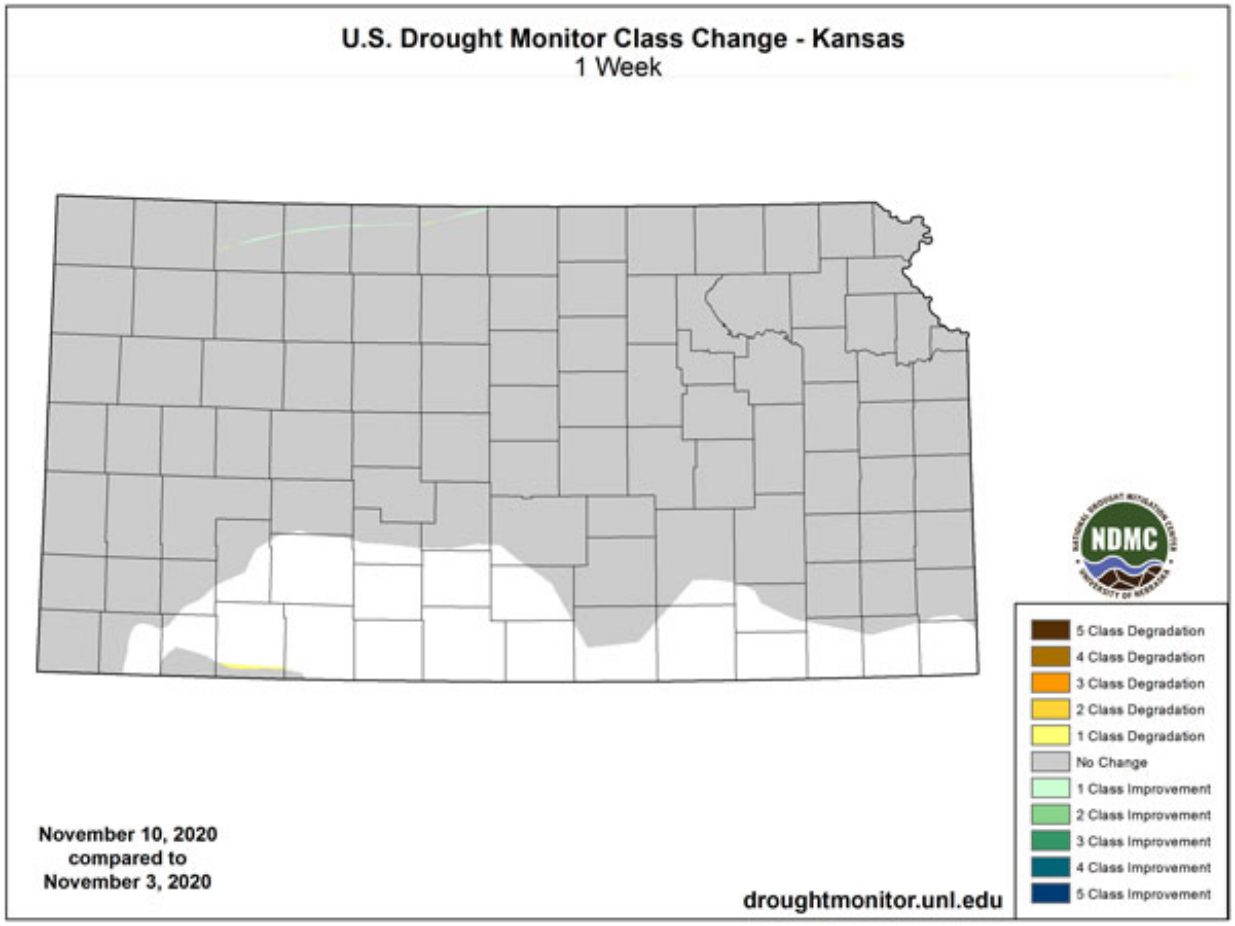

Figure 5. Change in weekly drought status (U.S. Drought Monitor).

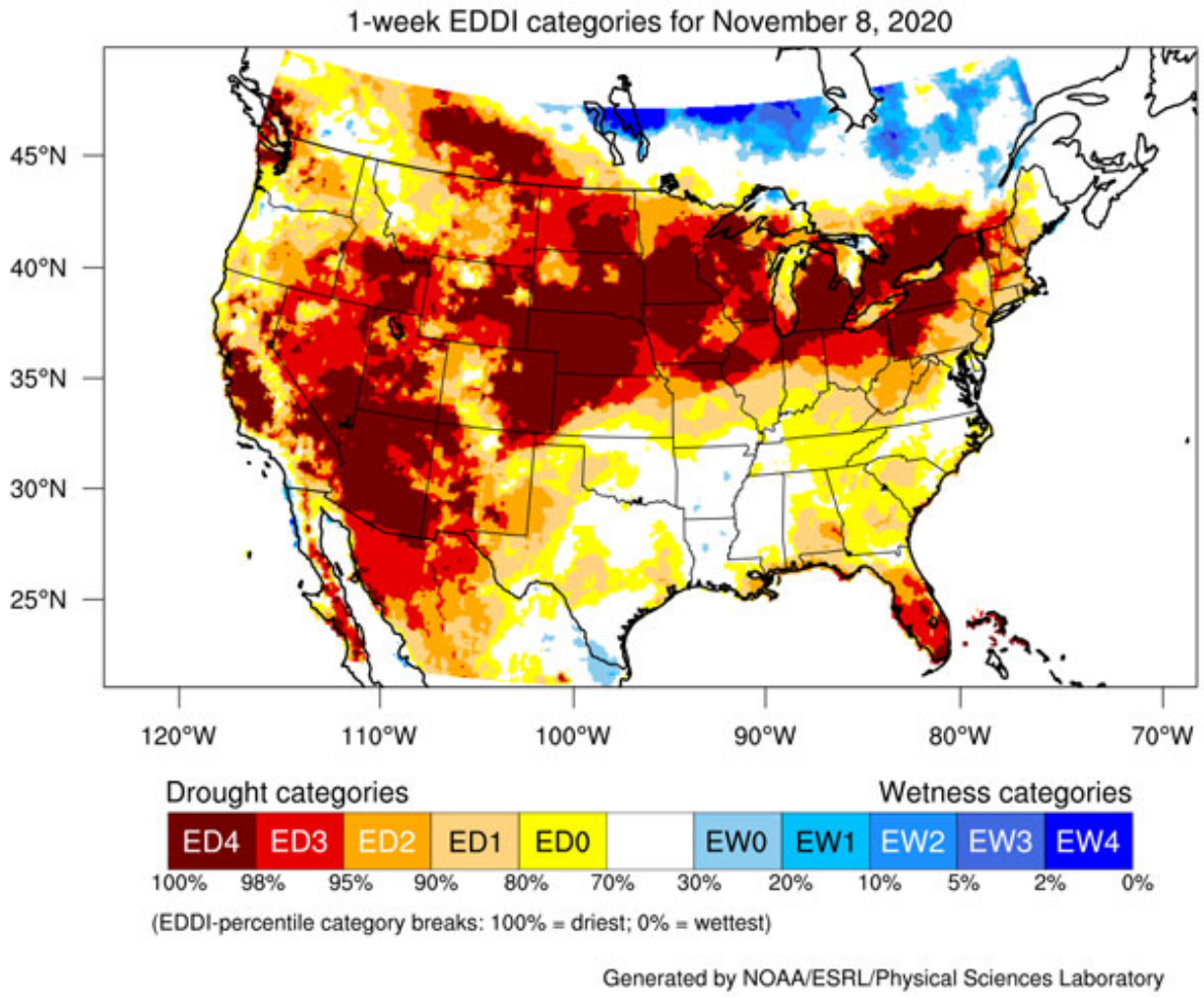

Figure 6. Evaporative Drought Demand Index factoring evaporative demand in respect to wind and moisture availability (NOAA, https://psl.noaa.gov/eddi/).

In the upcoming week, moisture will again be varied (Figure 7), with no precipitation expected in the west and central parts of the state. Some precipitation is expected in the far southeast, but will likely still be below normal (weekly average statewide precipitation for early November is 0.3 inches in the west to 0.8 inches east). A big change in the weather is possible beyond next week with a chance of above normal precipitation (Figure 8). However, temperatures are still forecasted to remain above normal. As we move later into November, average precipitation across the west continues to decrease, while remaining steady in the east. Outlooks for the entire month of November favor above normal temperatures and below normal precipitation statewide (Figure 9).

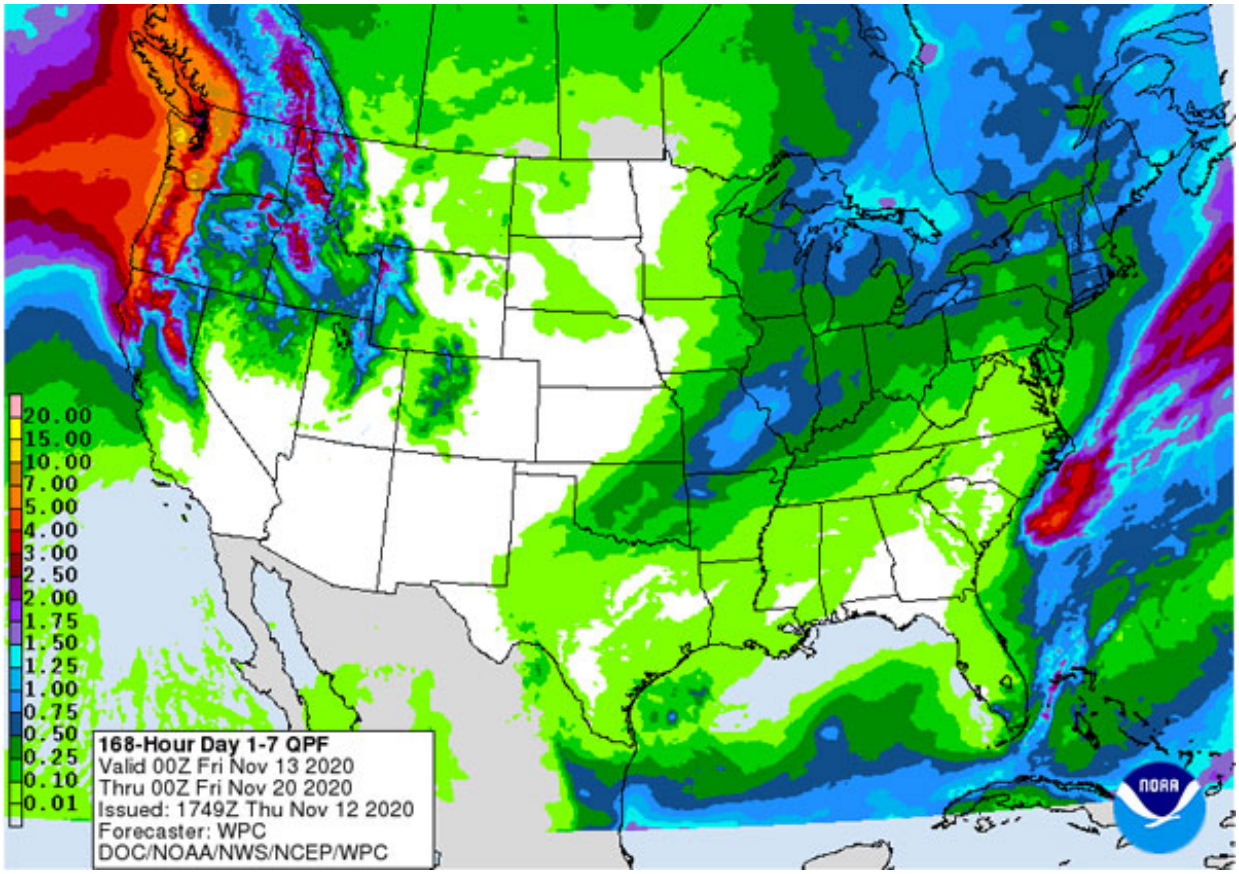

Figure 7. Quantitative Precipitation Forecast for week ending 10/15/2020 (Weather Prediction Center)

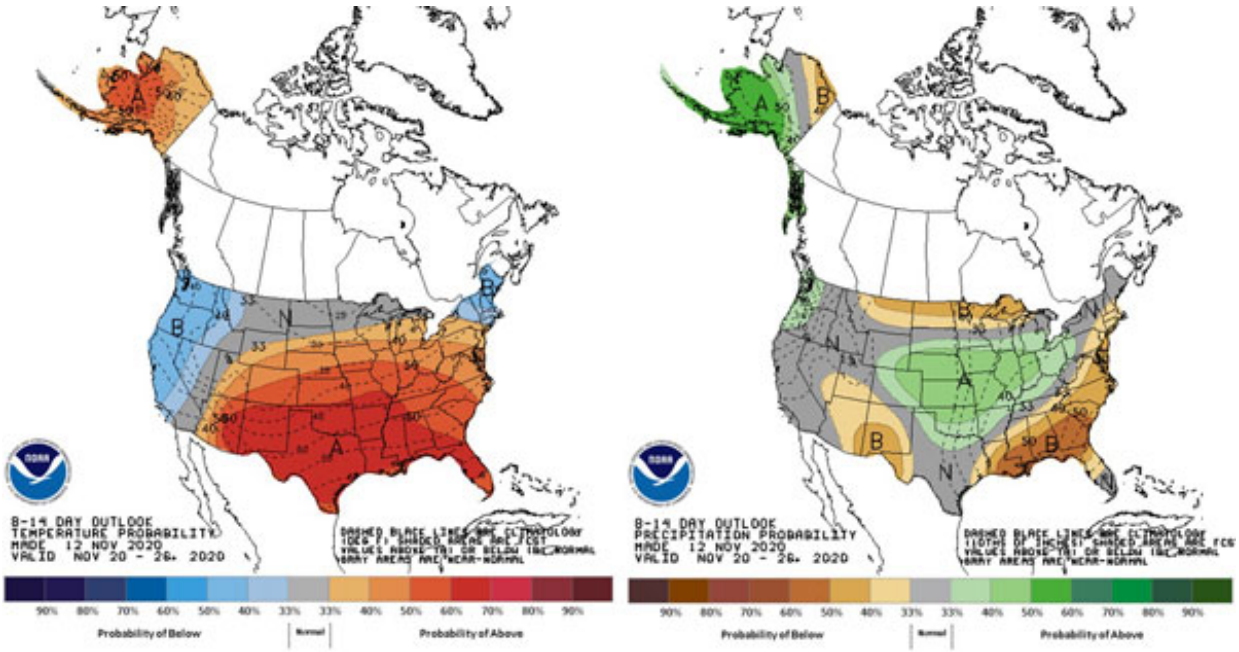

Figure 8. 8-14 day temperature and precipitation probability outlooks for Nov 20-26 (Climate Prediction Center).

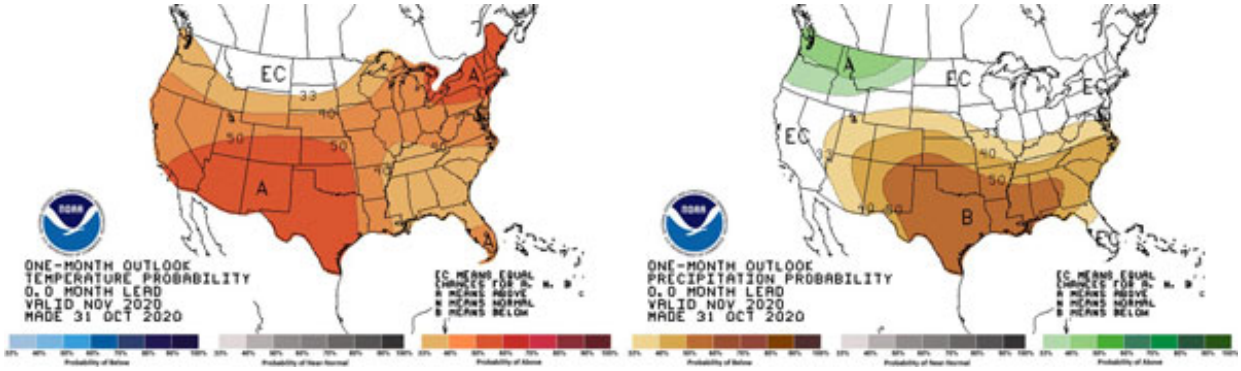

Figure 9. Temperature and Precipitation Outlook for November 2020 (Climate Prediction Center)

Highlights

- North Central Division received the most precipitation.
- Much warmer than normal temperatures statewide.
- No change in US Drought monitor for Kansas.
- The precipitation outlook for the week ending 20-Nov is dry for most of the state.

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5. Special Update - 2020 Crop Pest Management Schools

Due to recent increases in COVID-19 cases across Kansas, the Crop Pest Management Schools will be moving to a virtual format. At this time, details of the new format are still being finalized. If you already registered to attend one of these schools, you will be contacted with more information on the new virtual delivery format.

The eUpdate will send out more information on the revised virtual format and how to register (or re-register) to attend one of these schools. Thank you for your patience and we look forward to "seeing" you at one of these schools soon!

For more information, please visit:

www.midway.ksu.edu

www.goldenprairie.ksu.edu

www.phillipsrooks.ksu.edu

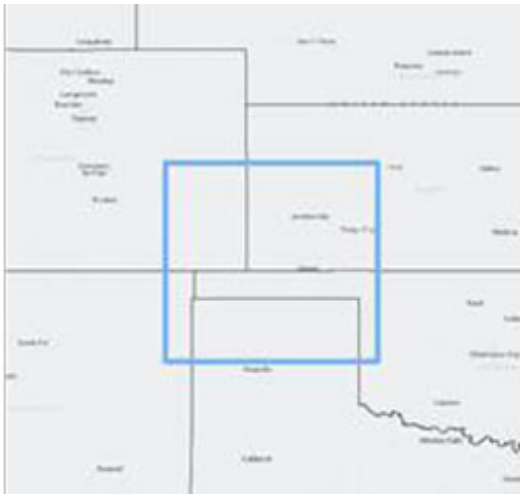
6. Food-Energy-Water study in central High Plains asks for producers' input

Looking for ways to expand your farm or community's revenue base? To help sustain farms and communities in western Kansas and neighboring states in the Central Arkansas River Basin, a Food-Energy-Water (FEWtures) study is underway to expand use of wind and solar energy to support agriculture. Researchers at the University of Kansas, Kansas State University, and elsewhere are evaluating technologies to use renewable energy for local scale treatment of poor-quality water and to produce ammonia. Ammonia can be used for fertilizer or to store energy for future use.

If you farm or ranch in or near the study, we'd appreciate your input and opinions. A map of study area and counties is listed below. The survey typically takes about 10 minutes to complete.

FEWtures Survey

Or paste this link in your browser: https://kusurvey.ca1.qualtrics.com/jfe/form/SV_0HeVc5yanIcf3md



Counties in Central Arkansas River Basin Study Area:

Kansas: Barber, Barton, Clark, Comanche, Edwards, Finney, Ford, Franklin, Grant, Gray, Greeley, Hamilton, Haskell, Hodgeman, Kearny, Kiowa, Lane, Meade, Morton, Ness, Pawnee, Pratt, Rush, Scott, Seward, Stafford, Stanton, Stevens, Wichita

Colorado: Baca, Bent, Crowley, Kiowa, Las Animas, Otero, Prowers,

Oklahoma: Beaver, Beckham, Cimarron, Custer, Dewey, Ellis, Greer, Harmon, Harper, Kiowa, Major, Roger Mills, Texas, Washita, Woods, Woodward

Texas: Armstrong, Carson, Collingsworth, Dallam, Deaf Smith, Donley, Gray, Hansford, Hartley, Hemphill, Hutchinson, Lipscomb, Moore, Ochiltree, Potter, Roberts, Sherman, Wheeler

New Mexico: Curry, Harding, Quay, Union

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